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# First-generation undergraduate researchers: understanding shared experiences through stories

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If you want to know a person, you need to know their story. If institutions want to better support their students, they need to know them and therefore need to know their stories. First-generation students—a vital part of our academic communities—model qualities such as hard work, optimism, and perseverance. Academic settings, policies, and hidden curricula present challenges for first-generation students and often result in inequitable outcomes. Undergraduate research experiences (UREs) are one of the resource institutions that have to support these students. Little is known about the first-generation student experience in UREs. Using in-depth interviews, we collected the stories of first-generation biology students who had participated in UREs. A thematic analysis illuminated five themes of shared experiences: what to expect in college, parental support, intent to apply to medical school, mentorship, and becoming a researcher. Stories provide depth and details into these themes that cannot be highlighted using other methodologies. We share detailed accounts of the experiences of two first-generation students. By using portions of the original conversations, the students narrate their stories in their own voices. A dialogical method was used to juxtapose the two stories and to increase opportunities for reader reflexivity and introspection. We discuss how the stories relate to the literature and reflect on the power of that gathering and sharing stories of first-generation students' experiences.

## KEYWORDS

first-generation, dialogical, stories, undergraduate research, UREs

## Introduction

“If we want STEM to support the entirety of our diverse society, we must first employ a decent representation of that diversity in these fields.”—O'Hara, 2020.

Although no two people are the same, there are common threads that bind us together as humans. These threads, this understanding of what makes us human, are often found in the telling and hearing of stories. Nasser (2018) reminds us, “There are, effectively, an infinity of stories out there, just waiting to be found and told.” If you were to answer the question, “Why are you reading this article,” what would you say? Whatever the reason, there is a story that leads up to why you are here. Stories provide us with reflections and details into lived experiences that can be found in no other way. In this study, we present the experiences and stories of two first-generation students who participated in an undergraduate research experience (URE).

First-generation students—students whose parents or guardians have not earned a bachelor's degree (Soria and Stebleton, 2012)—are a vital part of the academic community, bringing diverse racial, ethnic, and socioeconomic lived experiences to campuses and classrooms (Dika and D'Amico, 2016; Evans et al., 2020; National Data Fact Sheets, 2020). Diverse experiences and perspectives in our academic communities promote personal, social, and cognitive growth as well as group and problem-solving skills, and improve key learning outcomes on campuses (Hurtado, 2001; Terenzini et al., 2001; Strayhorn, 2009). While first-generation students model qualities such as hard work, optimism, and perseverance, academic settings, policies, and hidden curricula present challenges for first-generation students and often result in inequitable outcomes (O'Neal et al., 2016; Ives and Castillo-Montoya, 2020; National Data Fact Sheets, 2020). Documented institutional and social barriers impacting first-generation students include less academic preparation, lower confidence in a university setting, lack of knowledge of how to approach faculty, social difficulties, financial inequities, and a greater likelihood of stress and depression (Soria and Stebleton, 2012; Katrevich and Aruguete, 2017; National Data Fact Sheets, 2020). Institutions have a responsibility to address these inequities.

Undergraduate research experiences are mentored research experiences that are considered high-impact and are known to support students with a wide variety of backgrounds (Kuh, 2008). Through participation in UREs, undergraduate students collaborate with and are mentored by faculty while conducting research, providing valuable experiences for students (National Science Foundation, 1989). Students, including first-generation students, who participate in science, technology, engineering, and mathematics (STEM) UREs describe a variety of benefits including developing research skill confidence, overall gains in knowledge, how to work independently, and how to cope with obstacles (Lopatto, 2004; Russell et al., 2007; Harsh et al., 2011). UREs are associated with positive outcomes for first-generation and other students marginalized in STEM. These outcomes include increased student persistence, retention, greater integration into the academic environment, higher graduation rates, and increased participation in post-graduate studies (Nagda et al., 1998; Lopatto, 2004). Although there is evidence in the literature that UREs can significantly impact first-generation students (Ishiyama, 2002; Strayhorn, 2010; Haeger et al., 2020; Ruth et al., 2021), there exists a gap in the literature regarding the lived experiences of first-generation students who participate in UREs.

We use stories to make sense of the world around us, and they provide a uniquely reflexive approach to data, allowing for an emotional connection between the teller and the reader (Lewis and Hildebrandt, 2019). Such connections, which have been shown to cross lines of culture and race, rarely surface in other forms of inquiry (Carter et al., 2014; Rose et al., 2015; Reischer et al., 2020). Collecting and telling first-generation students' stories provides opportunities for insight into the nuances, richness, and depth of their experiences (in URES) in a way that other research simply does not (Yanow et al., 2015; Kim, 2016; McCall et al., 2021). Quantitative data and even brief quotes in qualitative studies only provide readers with a momentary connection with the speaker and limit our understanding of the student experience, whereas the presentation of participants' stories allows the reader to connect

more deeply and draw their own conclusions (Elo et al., 2014). We present the stories here using a dialogical approach (Leung and Lapum, 2005; Pithouse-Morgan et al., 2012; Carter et al., 2014; Norris et al., 2016). Dialogical methods are used to promote both author and reader reflexivity. The juxtaposition of stories allows the reader to immerse themselves in the conversation, creating room for the reader to reflect upon their own experiences and how they relate to the stories being told (Carter et al., 2014; Norris et al., 2016). The interplay of two stories with one another adds an additional layer of depth, bringing out aspects of the original stories to the reader that otherwise may remain obscured (Frank, 2002).

## Methods

In-depth interviews provide an exploratory methodology for investigating student experiences (Berry, 1999; Dworkin, 2012). This study used an in-depth interview approach to explore the experiences of first-generation biology students who participated in UREs. Through semi-structured interviews, participants shared their unique stories and experiences related to conducting research.

## Participants

Purposeful sampling was used to identify participants at a university located in the Rocky Mountain Region. The inclusion criteria for the study included the following: participants had to (1) be currently enrolled at the university as a biology major and (2) have previously or currently participated in an upper-level research course at the university in which students conduct independent research under the direction of a faculty member for credit. While students may also have participated in the research, not for credit, this latter criterion established a more uniform set of requirements. Potential interviewees were contacted with an IRB-approved recruitment email; four students, all of whom identified as Latina, agreed to participate in the study.

## Ethics and confidentiality

This study was approved by the University of Northern Colorado Internal Review Board (document 6074, protocol # 2007007949). Before joining the study, participants were required to complete a written consent form that encompassed both the interview itself as well as permissions for the recordings, transcriptions, and future analysis. Confidentiality was extended to participants through assigned pseudonyms which are used in the presentation of these findings. One of the limitations of in-depth interviews is the potential for research bias to influence the interview and the analysis of the data (Morris, 2015). CMH—As a non-traditional, continuing-generation student, I approached the interviews and analysis with the recognition that my experiences as a biology undergraduate student differ from those of the participants interviewed. As such, I worked to acknowledge my own biases so that I could better learn from the participants. SMK identifies as a first-generation student and scientist.

## Data collection

Single, 30- to 45-min semi-structured interviews were conducted over a password-encoded video conference call. An interview guide was used for consistency (see [Appendix](#)). Students were asked questions relating to their background in science, their experience in freshman- and sophomore-level lab classes at the university, their experiences conducting independent research, and how being first generation affected their academic choices and experiences. To facilitate note-taking and future data analysis, audio and video feeds from the meetings were recorded. The interviewer also hand-recorded notes and impressions both during and immediately following each interview.

## Data analysis

Interview recordings were transcribed with the assistance of the program Otter.ai. The transcripts were checked and corrected for accuracy. Minor editing was done to remove some of the distracting filler words, such as “like,” “um,” and “you know”, when they took away from the reader’s ability to understand the discussion ([Poland, 2002](#)). Manual coding and thematic analysis were conducted by the first author for all four interviews. For sense-making, *in vivo* coding was used for first-cycle analysis, and words and phrases from the transcripts that described the lived experience were identified ([Saldaña, 2021](#)). Second-cycle pattern-coding analysis was then used to group similar concepts and identify patterns between transcripts ([Saldaña, 2021](#)). Finally, an inductive thematic analysis of the data was conducted to identify overarching themes from the pattern analysis. Five major themes of shared experiences became evident: what to expect in college, parental support, intent to apply to medical school, mentorship, and becoming a researcher.

## Storytelling

Qualitative research methodologies including case studies, narratives, and duoethnographies have utilized small studies, including single- and dual-person studies to investigate lived experiences and point toward possible greater trends ([Doughty Horn et al., 2016](#); [Matapo and Leaupepe, 2016](#); [Moloney and Wang, 2016](#); [Rose and Montakantiwong, 2018](#); [Banegas and Gerlach, 2021](#); [Birney et al., 2021](#)). In the results, we present stories from two of the students: Julia and Adriana. It is common in qualitative research for investigators to share only a few exemplifying quotes from a much larger body of data in an effort to give an authentic voice to the larger group of individuals in the study ([Corden and Sainsbury, 2006](#); [Lingard, 2019](#); [Eldh et al., 2020](#)). When determining how to best share the stories in our study, we realized that if we wanted to convey their depth, we could not include all four interviews. After repeatedly revisiting the original transcripts, we chose to omit two of the stories: One participant was a graduate student at the time of the interview, making her reflections more retrospective in nature. The other participant was a non-traditional student with college-age children of her own, making her life experiences significantly different from the other three. Julia and Adriana, both

undergraduate students, provided the most abundant and in-depth information in their interviews, which allow readers to connect more deeply with the individuals. It is this connection we hope to promote in this more humanistic presentation of STEM research. Our goal was to convey the depth and richness of the individual lived experience.

As noted in the introduction, we apply models of dialogical presentation to share the stories of these two students ([Leung and Lapum, 2005](#); [Pithouse-Morgan et al., 2012](#); [Carter et al., 2014](#); [Norris et al., 2016](#)). We share the stories in sections as they relate to the five themes rather than in a linear fashion. Reconstruction of narratives is a well-established practice for making sense of the stories or finding the story within the stories ([Polkinghorne, 1995](#); [McCormack, 2004](#); [Ford, 2021](#)).

## Results

We present here the stories of Adriana and Julia, unbroken by researcher commentary so as not to disrupt the flow and reader connection. Analysis of the experiences within the themes is provided in the discussion section.

“Maybe stories are just data with a soul.”—[Brown, 2010](#).

## What to expect in college

Adriana: People say, “Oh, yeah, like when my brother and my mom went to college, they told me to make sure for this and look after that.” But even in other aspects, like even financially, I have friends as well [say], “When my mom went to college, she did this. And then she was able to save money. And then she took out this loan, but she didn’t take out that loan.” And even when I first joined, I was like, What are loans? What is this? I don’t, I didn’t know how to read my financial aid package. I didn’t know what to sign up for. Just even, even when I chose my degree, to what degree I was like, bio, and they’re like, okay, and I was like, okay, cool. That sounds great. Um, so it was just, it’s been a lot of like, kind of pick and choose and hope for the best for me, was like different forms that were given. My parents are like, I don’t know what that is, like, you know, you can call someone and figure it out because we don’t know.

Julia: There’s a certain level of support that is there that you don’t, that, I feel like a lot of people take for granted because they don’t know without it, that your parents have gone to school. Because there is a certain level of understanding there. As far as, whether that be financial help, or whether that be emotional support, or a sense of understanding. Um, not that it’s anybody’s fault. But I think that when your parent has gone to college, there’s that better understanding of what you’re doing and why you’re doing it. And more of a drive for it to be kind of the standard as far as—which stinks because I would never ever force my kids to go to college, just because that’s my own belief—but, it’s definitely more of like, okay, your dad and I did it, sort of thing...you have that kind of hope to see that future.

So yeah, there's several times that I either transferred or dropped just because I was like, I don't have the help that I need. I'm doing this all by myself, and I'm just lost.

Adriana: And just even navigating through it, like not knowing that I could burnout or that there was going to be times where I would get really stressed out or classes just going to be really difficult. And knowing that that's normal. I didn't know, I thought I'd have to do a lot at the beginning and just keep going and strive for that perfection. But I wasn't sure if that was normal, that was the college experience, and not knowing even what any college experience was.

Julia: Had someone come to me freshman year and been like, "You're human, and you're probably going to cry, but it's all worth it... This is the bigger purpose." Had I had that guidance earlier, that would have just been that much better.

Adriana: I always thought maybe if I wasn't first generation, I'd be doing better right now. And what I would be compared to my other peers. And I just feel like my other peers just knew how to really center the time around their studies, because in high school I was doing well, but that was high school, you know, you could kind of just almost get through high school and be okay. So then when I went to college, I realized, Oh, I have to actually study now. Like, I have to really put more time, I can't just passively read my notes and hope for the best. I have to internalize everything now. I think for the first two years, I struggled with that. And then I found out I was like, "Oh, this is how you take notes." And so yeah, it's been a process for sure.

Julia: I'm thankful for it being my own experience. But yes, I do think it's very different than the traditional students' experience for sure.

## Parental support

Adriana: My family has been really supportive about everything, and I'm very grateful for that. I have met some of my peers who also grew up in... Latin-based homes. And their parents are just been like, "Why? Why would you bother go to college? Like, you should just go work instead, you'll get more money." But what my parents have always told me, although, yes, that is important. You know, a good work ethic is good for later on. But my parents have always thought of college as an investment. So even though I'm not going to see immediate, like, funding or anything right away, it'll benefit later on as I, like, move up in my higher education.

Julia: My parents have always been very, very supportive of me going to college just because they know how important it is to what I want to do with my career. Unfortunately, I don't really have a career path that would work without school. And school has also been something that I've really fallen in love with. So they were always very supportive. But that being said, there was a certain level of like misunderstanding as far as why are you spending all this money to go to school and especially for me, because I was transferring so many times.

And I think just, too, just in general, the value of education being a lot different just because my parents have luckily become, you know, very successful given their circumstances without having

a college degree. So that has definitely been a very big gap as far as them understanding that portion.

For me, whenever it got tough, my parents were like, "Are you going to drop out?" That was the alternative. And I did several times.

Adriana: My parents never questioned the fact that I would go to college.... And I think if it wasn't for, like, their support, I may have dropped out my first year, but they kept pushing me. They always told me, you know, think of the end result, Adriana, like, you can do it, it's gonna be okay.

They've even mentioned like, oh, if we have to, like, file bankruptcy on the house, so be it, we'll do it, we're gonna get you through this no matter what. And I'm like, you're joking, right? And they're like, no, and I don't think they're joking. There have been semesters where my tuition bill has been higher... so we have to pay out of pocket. And then I've noticed, like, I don't think they'll ever admit it, but I know that my parents have... sold some of their personal belongings to help. And I've been like, "Hey where's this thing?" And they're like "I don't know, might have misplaced it." Their whole lives, they've given up a bunch of things so that I could have a better future.

Julia: My money is coming out of my pocket.... Now on the back end of it like, I'm so happy that I got to do that by myself. I'm very, very thankful how independent that entire education felt to me because that's something that no one else can take away from me and that is so unique about me and you know, makes me so proud. And makes my parents proud, of course. It makes me feel good to know that I can do difficult things.

They've been very, very supportive. As far as me doing whatever that I need to do to, you know, make it to where I want to go, even if they don't really understand it a ton. My mom is in health care administration, so she loved the idea that I was going into science. My dad is very artsy fartsy. So he'll always be like, "Chase your dreams." They were pretty cool about that.

Adriana: I really appreciate that they've never questioned anything. I remember even I was like, "Hey, awhile [ago] I wanted to major in music.... What would you have thought about that?" And they're like, "You know, you do whatever you want to do. Like, it's ultimately your dreams."

## Mentorship

Adriana: I think one of my, like, more prouder moments with science, was back in middle school. So every year at the end, they do kind of like a little award ceremony. And one of them, I remember sitting next to my friend, and they were like, "All right, next up, we're gonna announce the seventh-grade science student of the year." And we're both just like, "Oh, man, so and so's probably gonna get it." And then they called my name. And I was like, "What? Why?" So I've got a little medal. I still have it somewhere.

And then afterward, I went up to my teacher. And I was like, "Wait, why did you give me this? I'm not the smartest science student." He goes, "No, it's not about being the smartest science student. It's about being a passionate science student. And I see you

really have a drive to do something more than just get through this class. I can see you go into science as a degree in college.” And I was like, “College?!” And he’s like, “Yeah, you know, you’re gonna go to college, right?” And I was like, “Well, I don’t know.” He’s like, “No, you have to, you can’t let this dream die.” And I was like, “Oh, that’s sweet.” So that’s kind of like, one of the good motivators that kind of pushed me with all of this.

Julia: Honestly, everything at [this university] just changed for me. I was at both bigger and smaller universities before then and had not gotten, really any administrative help at all. Um, and it was thanks to you know, a very select few teachers, honestly, and administration at [this university] that like, completely sold the experience. I needed someone to help me more than just making a schedule type of thing.

And that’s what I was looking for was that mentorship and kind of being like, okay, I need some direction, I need to be challenged. But I need the help to do that. Because I’ve never done this. And it’s really hard. And I could just use some, like, direction as far as, like, what I need to do other than just, “Oh, well, you haven’t messed anything up yet. So just keep doing that.” It’s like, well, I don’t want that to be the standard. I want to be applying to PA schools and applying to medical schools or whatever else with people who have their families go to college and have that help. And I want to be on the same playing field. Me not having my parents go to college, will not and should not ever deter me from really shooting for the stars. So a lot of that was me learning to be really stern with administration. And kind of like, no, this is what I need from you.

Adriana: Something that I found really interesting with [a lab class] was, so every week we’d have to share results. And every week, our [organisms] would die. For the first week, I went into a panic. I was like, oh no, we’re going to get a zero. [The TAs] gonna hate us. So I went to his office hours and I was like, “Hey, like they’re dead. I’m so sorry. We don’t know what happened.” He goes, “No, that’s okay. It happens.” And I was like, “What?” He goes, “Sometimes no data is data. Because it’s not always gonna follow through. You may not even see what you expect. Because that’s part of research. It’s okay.” And I was like, “Wait, really?” And he’s like, “Yeah,” he’s like, “That’s how the labs are.” And I was like, “Oh, good to know.”

Julia: I chose Dr. Brown, um, just right off the bat because he was the only one that, pardon my language, had the balls to challenge me in the ways that I really, really wanted to be challenged. And he wasn’t afraid of hurting my feelings. And that was something that I really respected about him, and you know, from the get-go, he was very honest and blunt and was like, “You are not the first pre-med student I’ve seen in here and you will not be the last. If you want to do the work, and you know, dig your heels in then do that. But if not, like, don’t waste my time” kind of thing.

And it was that drive that I’d never been given. And something that it really made me consider was my privilege as your average college student to just be kind of skidding by, but then it’s like, no, you have to do the work. And if you don’t do the work, then I’m going to tell you that you’re not doing the work kind of thing. And so that really challenged me. Honestly, just as much as material, Dr. Brown sold me on it more than the [research] did at first, just because I knew that I was more so looking for mentorship than I was the research hours to be completely honest, to have some sort of direction in my life.

Adriana: A big lesson that I learned is to accept failure in research and that it’s okay. Because like [my TA] said, no data is data. So for a while, I was having some, just weird data observations. I’m like, “Oh, no, like, did I do it wrong? What am I doing?” But then after speaking with my mentors, they’re like, no, your question hasn’t really been seen before. So everything’s new. If you mess up, you mess up. And so I’ve been able to think of my research as a starting point, for further discussion, if anybody else wants to do the similar question, and then just be able to expand on that. So I’ve learned that even if, you know, I’m not doing ground breaking, like, solving the cure for cancer research, it’s still research, and it’s still gonna benefit something later on.

## Intent to apply to medical school

Adriana: [Interviewer: So back to your family, what do they think about your decision to major in biology?]

The saying is, your parents expect you to be either a doctor or a lawyer or something. And so they were like, “oh, cool, bio.” They’re like, but what kind of bio? And I’m like, What do you mean? They’re like, “There’s different emphases in biology. It’s not just like, ooh, bio.” And I was like, “I guess medicine.”

And I think if it wasn’t for their support, I may have dropped out my first year, but they kept pushing me, they always told me, you know, “Think of the end result, like you want to go to medical school. You can’t, you know, go to medical school, if you don’t have your bachelor’s.”

Julia: So when I turned 16, I got really lucky and I took a job as a nanny for a doctor. And so through that, I ended up getting to kind of volunteer and then do like a PRN at a medical office. And so through that, I just really fell in love with medicine. When I went to college, I was like, this is gonna be super hard, but then I kind of just went down that route. So I kind of went backwards, I really fell in love with medicine. And then I kind of tracked back and really fell in love with the science portion. And then that kind of carried me through to now.

Adriana: And then when I was considering joining McNair [scholarship program], I remember speaking with the directors, and they’re like, “Hey, you know, you want to go to medical school. If you show them you’re doing research, it really shows you’re driving your passions. So, you should do research, since [the university] has really great opportunities to let a bunch of undergrads join labs, as opposed to other universities that only, like, grad students do it. Take the advantage while you can.” So when I was accepted into the McNair Scholars Program, I knew that I’d have to do research regardless.

Julia: I was originally going on the nursing route to eventually go back into the medical field. Um, then going through nursing, I decided that it wasn’t really for me anymore. So when I transferred [here], instead of taking the nursing route, I was like, you know what, I really want to be a PA, because that was always kind of my intention. And then it just worked out that biology was a really great route, and let me do research and all that sort of stuff.

Honestly, like, raising my chances of getting into PA school was my first choice of like, even getting into the research field.

## Developing science identity

Adriana: And so I created a project. There was a lot of sit-down lab work that resulted in all of this. But I think realizing the importance of research has made me appreciate it more. Just, there's a lot of, like, steps to it. And then even though the sit-down parts at the computers, and all you're doing is like looking stuff up. It's still really important. And I think the big thing for me was, if I didn't see immediate results, then I didn't see its importance of research. But now, you know, doing all of the little things myself, there is an importance to it all. Because when you put it onto your paper, you're like, oh, like this is what it was all worth.

Julia: Doing research completely made me fall in love with biology. So that changed my entire attitude on how I look at science as a whole.

But truly, because I kind of went backwards in that, like, I could do well in my biology courses, and I was getting by and I was doing okay, but my first couple years of biology were just difficult for me because I was having a hard time kind of, like locking into it more than just like taking the test and doing well in the courses. And, doing research like, completely made me fall in love with biology. So like that changed my entire attitude on how I look at science as a whole. Honestly, it changed doing research.

Adriana: There's more passion behind it. Because it's something that I got to choose... how it's ultimately going to be. It was my project, I started it, and I'll see the end result. It's made me more comfortable with research, but it's also made me more comfortable with asking questions to progress. A big lesson that I learned is to accept failure in research, and that's okay.

It's been interesting. I also never thought I'd join a research lab. I just thought, you know, I'd go to college, leave. But it's helped me to understand more of why people pursue higher education as well. As I'm currently looking at doing a master's program in the fall of next year. And so just thinking, you know, it's not just like, I'm going to pick a school and go there. Now, I'm really thinking, "Okay, what kind of labs do they have? What research do they center around?" Could I be part of that team and do something more than what I'm currently doing and expand on different things. So it's, yeah, it's been very interesting.

## Discussion

As the reader, you've made your own connections with the stories and experiences of Adriana and Julia. Each story is situated within one of the five themes; we now consider how their experiences relate to what is already known about first-generation students in each area. As we reflect on how their stories add to what is already known, we do not suggest that their experiences are not unique. Rather we hope that by doing this, the reader will appreciate the depth and perspectives, the similarities and differences, added to the body of knowledge through each story, and the need to continue collecting stories of first-generation student experiences.

## What to expect

When asked if and how they felt their experience differed from their continuing-generation peers, Adriana and Julia expressed that their continuing-generation peers had a natural advantage of knowing what to expect in college from family and friends. They are not alone; other first-generation students similarly expressed that parents and families did not have the knowledge necessary to help them navigate college life (Evans et al., 2020). Our participants expressed that, while having loving and supportive families, their families did not have the prior experience necessary to help them navigate college life in areas such as how to study, understand financial aid, or work with college administration. Moreno (2021) notes that "Many times they [first-generation students] struggle with the lack of academic support from their family because their family does not know how to support them." Both Julia and Adriana wondered if they could have been even more successful as students had they had this scaffolding of knowledge from family and friends.

## Parental support

Adriana and Julia clearly felt supported by their parents. They shared that some of their first-generation student peers did not have this same support system, and both felt fortunate to have their parents support their college experience. In the literature, first-generation students report a range of feelings when it comes to their parents. Emotions may vary among them: gratitude, concern about how much money their parents spend on them, guilt about being academically successful when others in their family have not been, or feeling disconnected from parents who do not understand their desires to attend school (Irlbeck et al., 2014; Moreno, 2021). Parental support has been reported in other first-generation student literature as an asset to those who have it but certainly not ubiquitous among all first-generation students (Dennis et al., 2005; Irlbeck et al., 2014; Ricks and Warren, 2021).

Adriana's and Julia's parents want them to pursue their dreams and be successful, but they support their children in different ways. The value of school, expectations for graduation, and financial assistance differ between these two sets of parents.

## Mentorship

Interactions with and influence from mentors were repeatedly expressed as a central element of the research experience. Adriana was initially mentored by a middle school science teacher who saw and acknowledged her potential. Later, she benefitted from a PI and graduate mentor who helped her to see her research as a process rather than focusing on a specific result. Seymour et al. (2004) note that one important gain students obtain from UREs is the ability to think like a scientist. Julia's story highlighted the importance of mentoring in her decision to participate in research; she actively sought a PI who would help her to grow as a scientist and a person. Julia's experience differs from what Houser et al. (2013) discovered, suggesting that students focus more initially

on the research project rather than mentorship. Despite knowing that not all mentoring experiences are positive ones (Houser et al., 2013), these students attribute positive aspects of their research and personal experiences to mentorship received before and during their research.

## Intent to apply to medical school

Both Julia and Adriana planned to pursue medical degrees at the onset of their undergraduate studies. These plans appear to be one factor motivating the selection of biology as a major and their participation in research. The role of UREs and the intent to apply to medical school has been minimally explored in the literature. Medical schools highlight the importance of research on their applications, suggesting why intent to apply to medical school is a motivator to become involved in research (Vincent-Ruz et al., 2018; The Princeton Review, n.d.). In addition, it is interesting to note the growth of interest in the science and research that participants experienced while involved in a URE. This reflects the transformative results Villarejo et al. (2008) described for some of their pre-med students who, after participating in a URE, decided to pursue a science PhD instead. During the interviews, Julia was debating if she still wanted to pursue a career as a physician. Adriana was planning on going to medical school but had decided to get a master's degree first.

## Developing a science identity

Through their independent research, Julia and Adriana both expressed how their passion for biology increased as they developed responsibility and ownership for their research, which describes the development of a science identity. Hazari et al. (2013) describe science identity as “how students think science is ‘related to who they think they are,’” while Stets et al. (2016) describe science identity for some students as being “related to students’ interest in science, their persistence or tenacity in a science discipline, their intention to pursue a scientific career, and even their decision to enter a graduate science program”. In the literature, students exhibit increased science identities and the likelihood of pursuing a career in STEM as a result of participating in UREs (Hunter et al., 2007; Adedokun et al., 2012; Hazari et al., 2013; Hernandez et al., 2018). Julia noted how she originally did not enjoy biology but that changed because of her involvement in research. Adriana spoke of her selection of a graduate program as being influenced by her time conducting research. Both women spoke of the changes they experienced in their perspectives as students as a result of participating in a URE.

## Conclusion

Too often, the voices of first-generation students become lost in the larger body of data. The five themes and stories portrayed in this study hint at a greater wealth of information yet to be uncovered regarding first-generation student experiences in college and UREs. Although both stories share commonalities

and connections with the literature, they also highlight areas of the first-generation student experience that merit acknowledgment and further exploration and they offer insights for institutions supporting first-generation student populations. For example, it appears that some students choose to be pre-med because they are aware of other options. Institutions may consider connecting first-generation biology students with mentors who are actively involved with research or be more proactive about teaching students how to obtain research opportunities.

Adriana and Julia's stories remind us of the importance of not only exploring concepts broadly but also in greater depth. We recommend that individual lived experiences become a more prominent part of the documentation of UREs. Everyone is unique and has their own story to tell. It is important to take time to gather and tell stories, for it is in stories that we truly come to understand one another.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board, University of Northern Colorado. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

## Author contributions

CH responsible for experimental design, conducting and analyzing interviews, and the overall write-up of the article. SK responsible for closely guiding the development and implementation of the study, including the interview questionnaire and analysis, and heavily involved with revising and editing the manuscript. All authors were involved with the presentation of the stories using a dialogical method. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Appendix

### Interview protocol

#### Introduction

Thank you so much for volunteering to share your experiences with me today. As a reminder, if I refer to the term first-generation it simply means that neither your parents nor your grandparents graduated with a four year degree. If you have any questions about the questions I'm asking, please stop me and let me know so that I can clarify them.

#### STEM background

1. Would you describe for me your experience with science before you started college? (If they ask for clarification—For example, science classes you took, things you were interested in, outdoors experiences, books or museums about science that you liked.)
2. At what point did you decide to major in biology?
3. What motivated you to major in biology?

#### Freshman and sophomore coursework in college

1. We would like to better understand how the lab classes you took as a freshman and sophomore affected you as a student. If you would, think way back to the Copepod experience you had in a lab as a freshman. What was that experience like?
2. How did you feel about research or labs after this class?
3. Now, let's consider the sophomore lab where you had the unit on genomics. What was your experience in that lab class?

4. How did you feel about research or labs after this class?
5. In your opinion, do you think one or both of those lab classes had a positive or negative effect on your desire to do more research? What about on your desire to stay a biology major?
6. Is there anything else about freshman/sophomore labs I should know and did not think to ask?

#### Capstone class-independent research

1. What motivated you to choose independent research as your capstone class?
2. Which professor did/do you work in and what motivated you choose that professor to work with?
3. Could you tell me a little about your experience as an independent researcher? How do you feel about it compared with your lab classes?
4. Is there anything else about your capstone class I should know and did not think to ask?

#### Experience as a first-generation student

1. As a first-generation student, how does your family feel about your decision to go to college? What do they think about your decision to major in biology?
2. What are your future school and career goals?
3. How does your family feel about your plans for the future?
4. Do you think about being first generation when you are in the classroom?/Do you feel your experiences are different than others and if so, how?
5. If you were to meet an incoming freshman who was a first-generation biology student, what would you say to them, what would you want them to know?